STRIGA WORKSHOP

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THE STRIGA SITUATION

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Yield Loss

Striga, or witchweed, is a major cause of yield loss on the rainfed, dryland cereals of the semi-arid tropics in Africa, and is also a serious weed in large parts of India. Orobanche is a parasitic weed of similar type, damaging a range of dicotelydonous crops, especially in the Mediterranean region and the Middle East. My comments will be confined to Striga, but there are many parallels between these two plants, which no doubt will be brought out during the course of this workshop.

Reliable estimates of grain loss through infestation by Striga are few. A long-term trial at Ukiriguru, using the indigenous cultivar Bukura Mahemba and pulling the Striga on alternate plots every fortnight, showed serious grain yield depression on the Striga infested plots.

Some results from Ukiriguru, Tanzania, were as follows:

Grain Yields in lb/acre

Year	Striga pulled	Striga left	Percentage loss
1943-44	1200	120	90
1945-46	313	23	93
(stalks & heads)	4397	652	85
1949	530	10	98
1950	945	155	83

In another similar trial during the period 1956-59, mean yield loss was 50%, but in 1956 the yield of the plots in which the Striga was left was only 18% of that from the Striga pulled plots. This trial included the comparison with the variety "Dobbs" as well. The average production of the Dobbs plots on which the Striga was left was 70% of that from which it was removed. Dobbs overall yield levels were almost double those of Bukura Mahemba.

The numbers of Striga plants occurring on heavily infested black montmorillonitic clays were of the order of 100,000 to 300,000 plants per acre, and at these densities, a large proportion of the Striga plants remained below ground, still parasitizing the sorghum, but not emerging above the soil surface.

Estimates from a series of trials suggested that the average grain loss per thousand Striga plants lies in the range of 1.8 to 3.0 lb. In practice, the small cultivator stops growing sorghum on badly infested land, and says that the land will no longer grow sorghum. The crop plant may show serious evidence of damage before any Striga plants emerge above ground, and the weakened sorghum appears to be much more susceptible to stem-borer damage.

The Parasite

Although technically described as a hemi-parasite, Striga is nonetheless an obligate parasite. It is a highly successful plant, which has managed to overcome resistance mechanisms in its host very successfully, or it would not be with us so abundantly today. We would expect the Striga to have considerable genetic variability, for as resistance mechanisms appeared in the host population, new forms of the parasite which largely overcame these mechanisms must have been selected out of the Striga population. We would expect strains of Striga to exist, for exactly the same reason that there are races of rust on wheat, or of blight on potato, and observations suggest that this is indeed the case.

The survival of the parasite has also required flexible seeding and establishment mechanisms. Seeds are extremely small, and very numerous. Their germination processes require a pre-treatment period of moisture before germination can begin, and this allows the host plant time to establish and start growing before the Striga itself can be germinated. The Striga seed is germinated by the action of a stimulant produced by the host root. Once again, we may expect considerable genetic variability in the pre-treatment requirements of the Striga seed, and also in their reaction to root stimulants.

Control Methods

Superficially, control appears to be rather simple: get rid of the parasite before it can flower, no more seeds will be produced, and the parasite will be steadily eliminated. This works very well when the farmer has plenty of money. The reservoir of Striga seed in the soil can be steadily reduced through trap-cropping: in this system, a susceptible host crop is planted, and when it has been growing long enough to have germinated a lot of Striga seed in the soil, but before any of the Striga plants have had the opportunity to flower, the trap crop is ploughed in. Further, herbicides can be used to destroy Striga plants which do appear in the commercial crop, while the use of nitrogenous fertilisers has a depressing effect on the Striga while at the same time encouraging the growth of the crop. Thus, at Ukiriguru in 1942-43, plots manured with 20 tons/acre of farmyard manure yielded 1,000 lb/acre of grain in the presence of Striga, while the unmanured plots yielded 100 lb/acre. The farmer with money has few problems: he can clean up his land, and keep the amount of Striga at a low level through careful farming.

The situation for the small cultivator in the semi-arid tropics is far different. He does not have any inputs to spare, indeed, his cereal crops are generally grown with the barest minimum of inputs, because the inputs available to him are more profitably used in other areas. There can be no question of his having the resources for any undertaking such as growing a trap crop.

There are two main problems for the small farmer: firstly, how can land heavily infested with Striga seed be cleared up? Secondly, how can the numbers of the Striga parasite be kept at a low level which does not seriously affect grain yields? I shall look at the second aspect first, and especially at methodology which requires no cash inputs.

Keeping Down Striga Numbers

Striga and our crop plants have been living together in Africa for several thousand years and Striga resistant strains of the cereals have been developed. We need not presume that the resistance mechanisms are of the same kind in different geographical locations, nor yet in the same geographical location. Exploitation of this resistance is of the greatest importance: because of the probable variation in Striga strains, resistance must be tested at several or many locations. The plant breeders have the problem of identifying resistant plants in their segregating populations, and of distinguishing between the kinds of resistance, so that they may combine together two or more resistance mechanisms. We shall all listen with interest to ICRISAT's plans for handling this aspect of the crop improvement problem. Judging from the yields of Striga resistant materials known to me, I believe that it will be possible to double grain yields in areas where Striga is causing much crop loss. I have deliberately used the term "resistance", rather than tolerance, because tolerance could imply that the number of Striga plants was not reduced, but only that their influence on the host was lessened. I would regard this as highly dangerous: there would still be a lot of Striga seed being produced, and with the genetic variation likely to occur in obligate parasites, I think that this would just be an invitation to the parasite to develop strains which can overcome the tolerance of the host. Our aim should be to develop cereal cultivars which do not permit many Striga plants to come to fruition, but which show good levels of grain yields. As long as we obtain this, we need not dispute about terminology.

The second approach to reducing the Striga populations results from the fact that there are crop plants which will germinate Striga seed, but which will not act as hosts for the parasite, or else are such poor hosts that the parasite never flowers. Again, this is a system which can certainly work: many studies have been done on this aspect here in the Sudan. As long ago as 1904, Sir Francis Watt noted that the rotation of cotton and sorghum in India served to keep down the Striga levels, and quite a number of plants, especially legumes, have been identified in this category. However, we may run into problems of soil type and farm economics in trying to use them.

In the old days of shifting cultivation with small human populations, and plenty of available land, reduction in Striga numbers was occurring during the long fallow period. Now, under increased population pressure, it is becoming more and more common to find continuous cereal cultivation. One can rotate the cereal with a cotton crop only if there is an economic return from the cotton, and provided that sufficient food is available for the cultivator and his family. One looks with concern at the millet areas in the Sahel zone of West Africa, where so much continuous millet cultivation is taking place. Cotton is unlikely to be an economic crop there at the present time, and presumably the millet is being grown every year because it is needed for food. The possibility of cowpeas as the rotation crop needs to be studied. In my judgement, much research work remains to be done in order to establish cropping systems which will prevent the enormous buildup of witchweed, yet which will be profitable, in the broadest sense of that word, to the small cultivator.

The suggestion is often made that Striga can be eliminated by continuous clean weeding. No doubt this is correct in theory, but quite impossible in practice. Labour is the farmer's major limiting factor: he does not have enough to spare to achieve the elimination of Striga in this way.

Another way to prevent the Striga producing many seeds could be by encouraging appropriate pests and diseases, i.e., through biological control. There would seem to be scope here for trying inter-changing Striga pests and diseases occurring in West Africa, East Africa, and India.

Control Methods Requiring Some Inputs

There are two control methods currently available to the farmer, which might deserve government subsidies. These are:

1. the use of fertilisers, especially nitrogenous fertilisers
2. spot spraying with herbicides

A third possibility seems to have an important potential if synthetic Striga germinating stimulants (strigols) could be applied to the soil as powders or as solutions, in an appropriate part of the season. It might then be possible to germinate the Striga seed in the soil in the absence of a host plant on which it could grow and reproduce. You will be hearing in this workshop the progress made in producing synthetic stimulants of this type. We have been sadly deficient in field testing their effectiveness. I hope that we shall be able to come up with serious proposals on doing this. One might well be able to apply such stimulants to a non-host crop such as cotton, groundnuts, or cowpeas rather than to fallow land, thus enhancing the existing rotation effects of such crops.

The Reclamation of Land Heavily Infested With Striga

It seems certain that government inputs will be required here: all we can do is to develop the most economic methodology to use. We shall be hearing of the methods being tried in the U.S.A., but with the intention of eliminating the parasite, rather than merely reducing its incidence to a low level. Evidently, trap-cropping can go part of the way towards doing this: and we shall hear of the value of ethylene injection. However, the synthetic strigol compound may also be of great benefit. A combination of ethylene and synthetic strigol could prove to be the most effective system for destroying Striga.

General Comments

I have stressed the seriousness of Striga in our cereal crops, and have endeavoured to outline the various approaches which can be adopted to control this parasite. We shall be learning much in all areas on which I have touched, and possibly in others beside. The purpose of this workshop is to familiarise ourselves with what other workers are doing, to arrange for future co-operation, and to try to develop comprehensive, well-balanced control methodologies.

I have not dealt with Orobanche, yet feel certain that the Orobanche workers will want to look at their problem in similar ways to those which I have outlined for Striga.